The Invisible Rhombic

The rhombic is generally considered to be the king of antennas as far as performance goes. Trouble is, you need four tall supports in a clear area to erect one — unless you make it a Stephenson rhombic.

By J. Gregg Stephenson,* W2OBX/W1DGC

Everyone knows that hf antennas should be erected high and in the clear as much as possible, especially for DX work. There are many situations amateurs encounter, however, where these conditions are not possible or perhaps not even desired for environmental or esthetic reasons. In particular, one may not want to clear out many trees in a wooded area just to provide for an antenna, especially a long-wire rhombic or V type.

Informal outdoor antennas have often proved quite effective during Field Day and similar temporary situations. I was encouraged to proceed with a permanent rhombic installation on three acres of Vermont woodland by an article in the November, 1936, issue of *QST* in which considerable success was reported with less-than-ideal rhombics.[1] The following information may be of interest to amateurs located amidst forested land where a virtually invisible, but effective, long-wire antenna is desired.

Construction

A simple, single-wire rhombic was designed by the compromise method.[2] It was erected using PVC-insulated No. 12 stranded copper wire, and merely draped in the trees at elevations varying from 30 to 45 feet. Each leg is 250 feet long (3.6 λ at 14 MHz), and the apex angle at the feed and end points is about 50 degrees. The approximate directions of the legs were first laid out with an elementary survey using compass readings corrected to true north and with the main axis pointing in the desired great-circle direction. The antenna slopes downward from the feed point to the far end about 5 degrees due to the average ground slope. This rhombic has been operated without termination and is fed by 600-ohm open-wire line through a Transmatch device. It exhibits broadband characteristics and is easy to load on any hf band.

Many methods were tried for getting the wire up in the trees, including fly-casting and a crossbow. The most effective method for working in dense woods and underbrush turned out to be just throwing a 3-oz fish sinker (painted bright red) with about 100 feet of braided nylon leader line (40-lb test), which could later serve to pull up the actual antenna wire. The toughest problem working in dense woodland is to avoid tangles in the throwing line and antenna wire. Our best solution was to flake out the throwing line carefully on a blanket or tarp before throwing the weight, and to proceed over no more than two or three trees at a time. The antenna wire should be premeasured and premarked for the bend locations, and pulled off of a reel near the feed point. Murphy is seldom absent from an operation like this, and considerable patience and the help of someone else (e.g., an understanding XYL) is really necessary. Conditions are most favorable in late winter or spring when there is good snow cover to suppress most of the twigs and leaves.

The Stephenson invisible rhombic at W1DGC/1, south central Vermont. The rhombic is fed with 600-ohm line running up to the gable peak at the near end of the cabin, and the No. 12 antenna wires run off into the woods near the tops of most of these trees.

The rhombic erected in this informal way runs right through tree branches (both deciduous and coniferous), and varies in both elevation and direction somewhat erratically along each leg. But on the average it traverses approximately the presurveyed route. The error of closure at the far end is about 25 feet, but this seems to be of no practical consequence since the antenna is not terminated.

After two years this antenna is still functioning well in all seasons. Because of the resilience of support and the long leg lengths, the rhombic has shown a remarkable ability to withstand blowdowns of branches and dead trees without breaking. However, it is necessary to patrol the wires once in a while and take any necessary steps to remove such problems. Abrasion of the wire against

*22 Arosa Ct., Greenlawn, NY 11740

[1] References appear on page 39.

branches has not been noticeable, and there has been absolutely no noise problem from wires touching tree branches, wet or dry.

Performance

This rhombic has been operated mostly on 14 MHz because this was the most useful DX band during available operating opportunities. Limited operation on 7 MHz and 21 MHz shows more-or-less expected results, but more experience is necessary to obtain good confirmation of performance on these and other bands.

Gain results are based on comparison with a well-situated groundplane antenna. Over 30 direct readings of comparative signal strength were obtained from cooperating DX stations, supplemented by observations of received signal strengths on the two antennas. These are crude measurements, to be sure, but the only ones readily available. They do focus on the final practical answer for amateur work — the perceived signal strength at the far end of the DX path, and effectiveness in receiving.

Its effective gain (averaging out fading and polarization effects) in the forward direction over about 30 degrees of azimuth seems to be at least two S units over the groundplane at 14 MHz (10 to 12 dB). In the reciprocal or back direction the gain appears to be less (about 6 dB) due probably to the antenna slope and attenuated reflected wave in the long wires.

The most surprising result to me was in discovering that, as a general-coverage antenna outside the main beam, this rhombic gives performance at least as good as the groundplane in *most* directions checked so far. Only one or two off-axis readings have shown a slight disadvantage on the rhombic. The apparent absence of deep nulls may result in part from the wandering nature of the legs as they are draped among the tree branches.

On 7 MHz, limited results so far indicate a forward gain over a wider azimuth of about one S unit (about 6 dB), but general coverage in other directions seems to be at least as good as the groundplane. The antenna loads and behaves about like a good general-coverage antenna on 3.5 MHz with no real directional characteristics, but experience here is very limited. Results on 21 MHz are also limited, but performance similar to that on 14 MHz is indicated.

No significant difference between summer and winter operation has been noticed despite the great increase in surrounding foliage during summer. No doubt there is some power absorption from foliage, but the net effect is almost impossible to notice on the hf bands, even when the leaves are wet.

Some confirmation of the general behavior of informal tree-draped wire antennas has been obtained in another installation. A V beam with 270 feet per leg and an apex angle of 70 degrees showed about 6 dB gain along the main axis at 7 MHz. This antenna uses PVC-insulated No. 16 stranded copper wire, and the average height above ground is about 40 feet.

Lightning hazards are always of concern with antenna installations. We have taken the following precautions: (1) never operate during nearby thunderstorm activity; (2) when not in use, always ground the incoming feeders *outside* the house, and (3) disconnect all equipment from feeders *inside* and ground the inputs.

It seems well worth the trouble to erect long-wire antennas of this type in woodland to obtain significant gain in certain directions, quite good general coverage, with almost no impact on the environment. In fact, there is some whimsical satisfaction in erecting these invisible, but effective antennas. Lack of steerability and nonrejection of some unwanted signals are, of course, disadvantages. But they have not been at all serious for my particular situation.

References

[1] Hull and Rodimon, "Plain Talk About Rhombic Antennas," *QST*, November, 1936.

[2] Graham, "Long-Wire Directive Antennas," *QST*, May, 1937.

Strays

□ The Hallicrafters Co. has a new service address and is no longer a part of Wilcox Electric Inc. The address is 2501 Arkansas Lane, Grand Prairie, TX 75050. Telephone 214-647-9090.

STOLEN EQUIPMENT

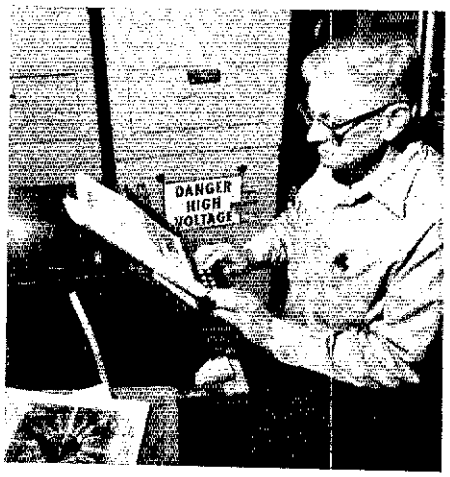
□ Standard SRC 826M 2-meter fm transceiver, serial no. 104207. Has KØKGA inscribed on receiver board; receiver crystal board has been rebuilt. Bill Myers, WBØMCS, 942 E. Mississippi, Denver, CO 80210. 303-777-3353.

□ Anyone desiring to list stolen amateur radio equipment may send the information to Colorado Council of Amateur Radio Clubs, c/o Charles E. Myers, WAØZCS, 1120 Yosemite Drive, Colorado Springs, CO 80910. Please include as much identification information as possible. Free distribution will be made to amateur radio magazines and all Colorado amateur clubs. Funds for postage and printing will be greatly appreciated.

QST QST QST DE W6QIE . . .

□ At 2000 Pacific time each evening except Monday, Don Johnson, W6QIE, begins code-practice transmissions as he has done for the past 12 years. During the 90-minute sessions, code ranges in seven steps from 5-30 words per minute. Since retiring from the U.S. Navy to his south San Francisco home, reports from as far away as Hawaii, Alaska and Florida along with other regular users attest to the good signal on 3590 kHz provided by 400 to 500 watts input and a dipole about 35 feet up. Earlier this year, Don added tone transmissions on 146.58-MHz fm, using 200 watts to cover the Bay Area nicely.

As if this were not enough, for more than 20 years he has held classes at his station twice weekly, teaching code and theory to would-be hams. His class this past spring was comprised of 50 students ranging in age from 12 to over 70. Don is also very active in RTTY traffic work on Navy MARS circuits.



Don Johnson, W6QIE, punches out a QST text on perforated tape, the first step for code-practice material before it is dubbed onto magnetic tapes used to key the transmitters. *(K6TP photo)*